HMS

HEAVY MOVABLE
STRUCTURES, INC.

# FIFTH BIENNIAL SYMPOSIUM

November 2nd - 4th, 1994

Holiday Inn Surfside
Clearwater Beach, Florida

## SESSION WORKSHOP PRESENTATIONS

# "THE TARENTUM BRIDGE PAINTING PROJECT - CASE STUDY"

by RICHARD A. MILLER, Pennsylvania D. O. T.
& CARL ANGELOFF, P.E., Miles, Inc.

HEAVY MOVABLE STRUCTURES, INC.

CLEARWATER, FLORIDA

NOVEMBER 1994

# THE TARENTUM BRIDGE PAINTING PROJECT - CASE STUDY

Richard A. Miller, Pennsylvania Dept. Of Transportation
Carl Angeloff, P.E., Miles Inc.
Pittsburgh, Pa

Officially named the George D. Stuart Bridge, but known in the area as the Tarentum Bridge, the span was constructed in 1950 as a three-lane toll bridge across the Allegheny River. The structure consists of a five span continuous deck truss portion with span lengths of 322 ft., two at 446 ft., 322 ft. and 248 ft. totaling 1,784 ft. The Tarentum side of the bridge (north end) consists of a series of simple span rolled beam ramp structures with a length of 1,006 ft. The total length of the truss span and rolled beam spans is 2,788 ft. Approximately 6,000 tons of structural steel (600,000 sq. ft.) will be painted under the contract.

In 1987, the bridge was widened to four lanes to handle increased traffic. Last painted in 1971 with an alkyd coating containing lead pigments, the bridge was originally supposed to be repainted when it was widened. However, at the time, new environmental regulations were enacted requiring PennDOT to change its coating specifications "so the painting portion of the project was delayed."

PennDOT Painting Specifications

The Department's current maintenance painting specification allows for two alternative coating systems for total repainting of truss bridges. Section 1071 of specification publication 408 permits the use of either a three coat polyurethane organic zinc rich system or an aluminum-filled mastic system. The contractor chose an approved paint system from the Department's qualified products list (QPL) of approved materials contained in Bulletin 15.

The project was bid on June 18, 1992 and the low bidder at $5,361,619.00 was E. Smalis Painting Company Inc. The contractor chose the polyurethane organic zinc rich system and the paint was supplied by Xymax Coatings Inc.

Notice to proceed was given on August 11, 1992 with an actual completion date of July 29, 1994. A cold weather shutdown period from October 31 until April 16 is specified.

This being the Department's first large scale containment project, two areas of the contract documents were rewritten to cover the unique aspects of this project.

Containment

The requirements for full containment called for a total enclosure utilizing 100% non-breathable tarpaulins. All seams and laps were clamped tight to prevent any material and dust from escaping the enclosure. The contractor used tarpaulins with an approximate burst strength of 500 psi.

The contractor is responsible for the design and effectiveness of the containment enclosure and filtering system. The enclosure design was completed by a registered professional engineer. This analysis included wind forces generated on the structure itself. The Department reviewed this design. Once the containment enclosure was constructed, the engineer was responsible for certifying the as designed installation. All blasting operations were specified to be halted during high winds that were sufficient to prevent the enclosure from effectively containing all spent materials and dust.

Air moving equipment was attached to the containment enclosure capable of creating a negative air pressure condition within. Air pressure must remain sufficient to prevent any material and dust from escaping during the blasting operation. When the blasting operation is performed within the design parameters, the negative pressure concept for full containment functions well. Adequate visibility must be maintained for worker safety and performance. Lighting is required to illuminate the work area to a minimum of 50 foot candles.

All exhausted air is filtered by means of a bag house. An acceptable alternate would be a truck mounted filtering system.

Worker Health Protection and Safety

This special provision was implemented to reasonably assure the health protection of the workers.

Requirements of the OSHA Lead Standard 29CFR Section 1910.1025 were followed in order to protect the workers from overexposure to lead containing dust. All applicable OSHA general and construction standards also were required. Where duplication of standards existed, the more stringent rules were implemented.

In addition to OSHA requirements, the contractor was required to perform the following:

1) Develop and submit for approval a worker training program to ensure enforcement and compliance with OSHA and Department requirements for worker health protection.

2) Provide third party monitoring of worker protective equipment to ensure the quality of the air breathed by all workers.

3) Provide facilities for worker clean-up, showering, lunch and storage of street clothes.

4) Monitor blood levels of all workers in containment areas. Workers are removed from further exposure when their blood lead levels reach 40 micrograms per deciliter.

Environmental Regulations

Three permits were required to initiate this painting contract. The Pennsylvania Department of Environmental Resources (PennDER) permit was required to protect the Allegheny River and surrounding area from environmental damage. The Coast Guard permit was required for protection of river traffic and water pollution. The Allegheny County Health Department required ambient air monitoring for the protection of surrounding residents. Also, the County required the use of recyclable abrasives and full containment using non-porous tarps.

Ambient air monitoring was performed during all blasting operations. Three monitors were strategically located by the direction of the Department of Health and moved accordingly as the construction sequence of operations progressed on the bridge or as wind direction or levels of blasting operations changed.

All air monitoring results were expressed in $\mu g/m^3$ for PM10 and lead.

On June 3, 1994, Secretary of Labor Robert B. Reich proposed the largest single-employer construction penalty to date against the painting contractor. OSHA's inspection found that workers removing lead-based paint were exposed to levels of airborne lead nearly 700 times the PEL.

The contractor was cited by OSHA in December of 1992. This citation came before 29 CFR 1926.62 was issued, but dealt mainly with the hazards of lead in the workplace. One violation resulted from the presence of a worker with a blood lead level of 153 µg/dl. The violation carried with it a penalty of $35,000. This citation, originally for a total of $73,000, was settled out of court in October 1993 for $50,000.

In the follow-up inspection, completed in December of 1993, 20 of the contractor's 90 employees were overexposed to lead. The employer allegedly failed to provide appropriate engineering controls and respiratory protection and failed to provide training on the hazards of working with lead. Other alleged violations included inadequate medical surveillance, the failure to remove employees with blood lead levels above 50 µg/dl, and the removal of three employees without medical removal benefits.

OSHA issued citations for nine alleged egregious willful violations with proposed penalties totaling $4,679,500; nine other alleged willful violations with proposed penalties totaling $301,000; and four alleged serious violations with proposed penalties of $28,000.

An egregious willful citation is defined as a violation of such a flagrant nature that separate citations were proposed for each instance of a violation. Willful violations are those committed with an intentional disregard of, or plain indifference to, the requirements of the OSH Act and regulations. A serious violation is defined as one in which there is substantial probability that death or serious physical harm could result, and the employer knew or should have known of the hazard.

The cost of the egregious willful violations comes from the cumulative quality of such citations. For instance, the absence of engineering controls and not keeping employee exposure to lead to below the PEL carries with it a maximum penalty of $70,000. In this case, however, 20 instances of this led to a total penalty of $1,400,000. A second example of the cumulative effect is the absence of a lead training program, which carries a maximum penalty of only $17,500. In this case, however, because the violation was egregious, this penalty was incurred for each of 70 employees for a total of $1,242,500. The total penalty is $5,008,500.[1]

Coating System

The three-coat polyurethane system was one of two paint systems approved for the job by PennDOT. The painting contractor selected the polyurethane coating system over a three-coat aluminum mastic paint system (two coats of an epoxy mastic with a polyurethane topcoat) because of its performance properties and substantial productivity advantages.

The polyurethane coatings have shorter recoat times and are expected to provide good corrosion protection, color and gloss retention for 20 to 25 years

The coating system specified for the bridge is a three coat polyurethane organic zinc rich system supplied by Xymax Coatings Inc. The system includes a one component moisture curing, zinc rich polyurethane primer and a one component moisture curing intermediate polyurethane coating containing micaceous iron oxide (MIOX). A light-stable two-component polyurethane topcoat is pigmented in a distinctive, light green hue called "Green Glory."

The corrosion resistant, zinc rich, moisture-curing polyurethane primer incorporates Miles' Desmodur aromatic polyisocyanates. The primer is being applied to DFT of 2-4 mils and can be topcoated in 2-4 hours. The high zinc loading of the primer helps to inhibit corrosion of the steel substrate by allowing the zinc to react sacrificially. The primer also provides good adhesion to SSPC-SP6 surfaces that may be subject to rust bloom.

The high-solids intermediate polyurethane coating incorporates Desmodur aromatic polyisocyanates and contains MIOX, which serves as a barrier pigment to provide the coating with excellent abrasion resistance and improved recoatability. The coating is being applied to the Tarentum Bridge to a DFT of 3-4 mils and can be topcoated in just 2-4 hours.

The aliphatic polyurethane color topcoat utilizes Miles' Desmophen acrylic polyol and Desmodur aliphatic polyisocyanate. It provides the exceptional gloss, color retention and chemical resistance characteristic of two-component polyurethane coatings. It is being applied to the Tarentum Bridge to a DFT of 2-3 mils and dries in 4-6 hours.

Because the polyurethane coatings are fast drying, the painting contractor stated that they allow him to work in the sequence he prefers.

"After a section is blasted, we can put on the primer, wait just a few hours, then apply the intermediate coating. Just a few hours after that, we can apply the topcoat and move on to the next section. With aluminum mastic, we'd have to wait a minimum of 24 hours between coats," he explained.

Each of the coatings meets current volatile organic compound (VOC) emission requirements of 3.5 lbs./gal. The moisture-curing polyurethane primer is well below current requirements, achieving a VOC emission level of just 2.8 lbs./gal.

Moisture-Cure Technology

The moisture-curing primer and intermediate coatings, which cure by reacting with water in the atmosphere, offer application versatility. They can be applied using brushes, rollers or conventional one-component spray equipment and they are much more forgiving of temperature and humidity conditions than most other types of coatings.

The Department's painting specification requires that the temperature be 40° F or more during paint application. The productivity advantages of the moisture-curing coatings is obtained when the temperature drops below 40° F and the paint continues to cure.

Other pertinent information from the manufacturer's product data sheets states that there is virtually no restriction on the temperature-dew point differential and that humidity levels can be as high as 99 percent. Also, the coatings can be applied to damp surfaces.

Construction Sequencing, Application and Operation

In addition to helping speed project completion, the fast-drying characteristics of the polyurethane coatings are beneficial in optimizing the use of the containment structure. Within that protective structure, workers can blast an adjacent segment of the bridge coated with old lead based paint, without contaminating nearby areas recently painted. This allows workers to blast and paint within the protected area of the containment structure before moving the entire containment apparatus to the next section of the bridge.

In the enclosed structure, the substrate temperature and other conditions are more easily controlled to optimize painting conditions. The 200-foot long containment structure, for example, helped enable the paint crew to finish their painting operation when they got caught in

the December 10-11 snowstorm that dropped about a foot and a half of snow on the Pittsburgh area. The blasted steel superstructure and the workers were protected by the roadway above them and by the containment structure.

The contractor implemented his containment structures for lengths of approximately 200-225 ft. The containment design was performed by Kozel Engineering Company Inc. and reviewed by the Department. The analysis addressed wind and vertical load effects imposed by the painting operations.

The contractor utilized two blasting units that were fabricated to his specifications. Each unit consisted of a blast pot, compressor, recyclable unit and an air dryer. While painting the approach girder spans, the equipment was stationed on the ground beneath the bridge. Painting the truss span over water required that these units be placed on the bridge deck, closing the curb lane to traffic. When the equipment was on the ground, the compressors generated enough energy to power six nozzles efficiently, however, when the equipment was utilized above the deck, eight nozzles could be easily maintained. The contractor chose recyclable steel grit to use as an abrasive.

The average number of blasters working during any daily operation was between four to six. Prior to blasting, the contractor sent work crews ahead of the operation with hand and power tools to knock off the heavy stratified rust. The blasted steel substrate was able to remain uncoated for several weeks without noticeable rust bloom.

The bridge crosses two mainline railroad tracks at each end. On the Tarentum side, the minimal underclearance required the use of railroad flagmen to control train operation. An example of the productivity savings that could be achieved using the three coat polyurethane system is best illustrated during painting of the railroad spans. The two spans over the railroad tracks were painted in one calendar day. The blasting operation was completed early morning and then all three coats of paints were applied in that same day.

Approximately 150 tons of non-hazardous waste has been generated. Analysis by an independent testing laboratory concluded that the lead content was 1.6 mg/l, which was well below the 5.0 mg/l threshold. This non-hazardous waste was disposed of at Chambers Landfill. This can be compared to the 5,500 tons of waste that resulted from the use of Black Beauty abrasive grit on the McKees Rocks Bridge painting project.

The community reaction to the painting project has generally been favorable. On the Tarentum side, businesses and residential dwellings abut the bridge. The majority of complaints were generated during the night time clean-up operations. The vacuuming equipment generated similar noise levels as the daylight blasting operation. As a reaction to the public complaints, the Department ceased night time operations. Overspray and odor complaints were negligible. The containment structure eliminated odor and overspray problems. The few complaints resulted from broken hoses and couplings. One example of a serious overspray problem occurred during the movement of the containment structure. A painting crew continued the painting operation and high winds carried the overspray to nearby buildings and automobiles.

Summary

Based on observations from this project, the following areas will be evaluated for future painting contracts:

1) More attention should be given to monitoring areas outside the containment structure such as the workers area, and the vicinity of the dust collectors and recycling equipment.

2) Additional dust monitoring should be done when the tarpaulins are being moved during relocation of the containment system.

3) A study should be made to determine if it is feasible to evaluate the number of nozzles that can be used in a contained area. Since each blast nozzle introduces air into the containment structure, ventilation design calculations should include this factor when determining the maximum number of blast nozzles which can be used simultaneously without creating a positive pressure condition inside the containment.

4) Worker health protection guidelines require more documentation to adequately identify workers and their medical testing history. Procedures need to be developed to track workers from job to job.

5) The 100 percent translucent tarps allow adequate light to perform the work in the daylight hours. Therefore, lighting is not a problem.

6) Recyclable grit substantially reduces the amount of waste generated and requiring disposal.

7) The containment structure offers additional benefits to painters. It can protect their work areas from inclement weather, and virtually eliminates overspray and odor complaints.

8) Investigate the probability of using heaters inside the containment to control temperatures so painting operations can continue during inclement weather.

[1] SSPC, Pb Lead Paint Bulletin, 94/3, page 6, 1994.

AUTHOR'S INFORMATION SHEET


| | |
|---|---|
| PRESENTING AUTHOR | Richard Allan Miller |
| COMPANY | Pennsylvania Department of Transportation |
| ADDRESS | 45 Thoms Run Road |
| CITY | Bridgeville, PA 15017 |
| COUNTY | Allegheny |
| PHONE | (412) 429-5036 |


EDUCATION (COLLEGE/UNIVERSITY) (DEGREE)

- Western Pennsylvania Institute of Technology - Structures

BRIEF WORK HISTORY (most recent employers and positions held)

- Swindell Dressler Engineering Company - September 1963 to August 1967
- Pennsylvania Department of Transportation August 1967 to July 1993 Title (Bridge Design Supervisor from 1975 to 1993). Supervised the Bridge Painting Program for District 11-0 from 1971 through 1993.
- Present Title - Highway Design Manager, Programming/Contract Manager - July 1993 to Present

PREVIOUS TECHNICAL PRESENTATIONS (Papers/Articles)

- Research Project 83-09B - Field Evaluation of Bridge Deck Cathodic Protection Strip System with Latex Modified Concrete Overlay
- 10th Annual International Bridge Conference (June 16, 1993) The Tarentum Bridge Painting Contract: Pennsylvania's First Large Scale Project Requiring Lead Removal with Total Containment

OTHER ACHIEVEMENTS (Patents, Awards, Technical Society Memberships)

- Secretary's Award of Excellence (1988)
- Member ABCD
- Member ASHE